THE ABUNDANCE AND HABITS OF LAELAPS ECHIDNINUS ON RATS IN NEW JERSEY[1]

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Several years ago an investigation was set up to make a complete study of the bionomics of rat ectoparasites of New Jersey as a cooperative project of the Department of Entomology, Rutgers University, and the New Jersey State Department of Agriculture. Among the ectoparasites collected was the mite, *Laelaps echidninus,* which is widely encountered on rats and was found in considerable numbers on rats in New Jersey.

The precise status of the mite *L. echidninus* (Berlese) as a disease causal agent vector has yet to be fully established. Even the exact constitution of the genus *Laelaps,* of which *L. echidninus* is a member, has been subject to a great deal of confusion. Despite the fact that this mite can only rarely be induced to feed on man and that Hirst in England uncovered only negative results in his attempts to transmit bubonic plague with *L. echidninus,* the ability of these mites to carry and transmit certain infectious pathogenic agents such as *Heptazoon muris* (Miller, 1908) among rats establishes them as organisms which are potentially vectors of disease.

Although the life history of this mite has been known since the work of Miller (1908), its biology has been rather neglected. No precise facts are known of its habits in a given locale.

L. echidninus (Berlese) is often found in the adult and nymphal stages as well as the less commonly encountered larval stage on several species of rats and particularly the Norway or brown rat, *Rattus norvegicus* (Erxleben), and the black rat, *Rattus rattus rattus* (Linnaeus).

Ectoparasite surveys have shown the distribution of *L. echidninus* to be more or less cosmopolitan. It has been recovered from *Rattus norvegicus* in London (Hirst, 1914), on three species

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, The State University of New Jersey, Department of Entomology, New Brunswick. A revision of a thesis presented to the graduate faculty of Rutgers University in partial fulfillment of the Master of Science requirements.

of rats in Malta (Zammit, 1918), and from rats in Lagos, Nigeria (Connal, 1926). It was also recovered from *Mus decumanus* in West Africa (Macfie, 1922) and from white rats in Toulon (Brumpt, 1946). In the United States the mite has been found in at least fifteen states.

The female probably lays eggs singly. The eggs hatch to six-legged larvae, which within a few days moult several times and become adult males and females. Unlike ticks the mites feed frequently and take only a small amount of blood at each feeding (Miller, 1908). Instead of blood meals, the males feed on animal or vegetable detritus. The mites apparently feed largely during the night; during the day they leave the host and live in the litter. When there are only a few hosts, the mites tend to remain on their respective hosts all the time and may be found in large numbers on the back of an animal. The female mite leaves the rat to deposit her egg in the litter.

Several methods, as described by Hansens and Hadjinicolaou (1952), were used in the collection of the mites used in this study. The original plan was set up to make a detailed study of rat ectoparasites from about twenty municipalities in that northeastern area representing metropolitan New Jersey by at least monthly collections of about twenty rats from each collection point. Secondly, outlying areas were to be surveyed throughout the State as time permitted.

Rats were collected predominantly from garbage and refuse dumps. Usually the rats were caught by driving calcium cyanide into their burrows and clubbing them when they were forced from the burrows. Parasites were then washed off the rats in an insecticide bath, and later the mature female mites were counted by means of a binocular dissecting microscope. Females were readily recognized by a characteristic arrangement of the plates located on the dorsal and ventral surfaces of the body.

Rats were collected from a total of seventy-six locations between April 1, 1951, and September 30, 1952. The large dumps where the rat and rat-ectoparasite populations were large were trapped more frequently than some of the smaller dumps, giving a better year-long representation where animals were more easily obtained.

At the sites visited, both sexes and all sizes of rats were taken. Only the brown or Norway rat, *Rattus norvegicus,* was encoun-

tered, and a total of 2,738 rats was collected. Table I presents information on *L. echidninus* on rats collected from dumps at one time or another during the survey.

TABLE I. *L. Echidninus* INFESTATION BY LOCALITY

County	Location	Total Rats	Per Cent Rats Infested	Average No. Mites Per Rat	Average No. Mites Per Infested Rat
Bergen	Englewood	31	71	9.9	14.0
	Fairview	138	50	3.9	7.8
	Hackensack	56	12	0.3	2.7
	Lyndhurst	16	50	4.5	9.0
	North Arlington	142	55	2.9	5.2
	Palisades Park	20	15	0.3	2.0
	Rutherford	24	62	13.7	21.9
	Woodcliff Lake	1	100	1.0	1.0
	Wood Ridge	23	17	0.3	2.0
Passaic	Bloomingdale	90	1	0.01	1.0
Hudson	Jersey City	168	39	2.5	8.4
	Secaucus	165	88	5.7	6.4
	Union City	109	50	4.8	9.6
Essex	Newark	189	76	9.3	12.3
Morris	Pine Brook	63	2	0.01	1.0
Union	Elizabeth	40	52	3.6	6.8
	Rahway	126	3	0.0	1.0
Somerset	Raritan	25	4	0.04	1.0
Middlesex	Perth Amboy	269	1	0.01	1.3
Burlington	Bordentown	33	82	16.6	2.2
	Riverside	29	10	0.1	1.3
Camden	Audubon	15	20	1.0	3.7
	Barrington	19	78	11.3	1.7
	Camden	11	73	8.0	11.0
	Westmont	7	74	20.7	24.1
Gloucester	Westville	8	25	0.4	1.5
	Woodbury	20	30	1.1	3.8
Salem	Pennsgrove	11	9	0.09	1.0
	Salem	23	8	0.5	6.0

Although the survey included points well distributed over the State of New Jersey, only certain areas proved to be inhabited by rats parasitized by this mite; and in large portions of the State, no specimens of *L. echidninus* could be found. The following points were inhabited by rats free of *L. echidninus*. After

each location the total number of rats collected is noted: Allentown (Monmouth County) 15, Atlantic City (Atlantic County) 12, Belvidere (Warren County) 21, Bernardsville (Somerset County) 40, Boonton (Morris County) 2, Bridgeton (Cumberland County) 16, Burlington (Burlington County) 15, Cape May (Cape May County) 6, Cranbury (Middlesex County) 32, Dover (Morris County) 10, Freehold (Monmouth County) 20, Elizabeth (Union County) 1, Englewood Cliffs (Bergen County) 1, Flemington (Hunterdon County) 55, Frenchtown (Hunterdon County) 2, Gibbstown (Gloucester County) 1, Hampton (Warren County) 1, Hackettstown (Warren County) 43, Hasbrouck Heights (Bergen County) 4, High Bridge (Hunterdon County) 30, Hightstown (Mercer County) 42, Jersey City (Hudson County) 28, Kingston (Middlesex County) 6, Lambertville (Hunterdon County) 13, Long Branch (Monmouth County) 15, Springfield (Union County) 1, National Park (Gloucester County) 7, Newark (Essex County) 4, Newton (Sussex County) 40, North Brunswick (Middlesex County) 3, Palmyra (Burlington County) 16, Pedricktown (Salem County) 5, Pemberton (Burlington County) 1, Pennington (Mercer County) 1, Pennsauken (Camden County) 11, Phillipsburg (Warren County) 31, Pittsgrove (Salem County) 3, Port Norris (Cumberland County) 2, Riverton (Burlington County) 3, Roebling (Burlington County) 3, Seabrook (Cumberland County) 19, Somers Point (Atlantic County) 1, South Camden (Camden County) 8, South Plainfield (Middlesex County) 1, South River (Middlesex County) 165, Teaneck (Bergen County) 1, Toms River (Ocean County) 1, Trenton (Mercer County) 15, Vernon (Sussex County) 3, Vineland (Cumberland County) 38, Washington (Warren County) 45, White Horse (Mercer County) 16, Wildwood (Cape May County) 4, and Woodbine (Cape May County) 1. At other collection points (Table I), mites were taken on at least one of the visits during the year. At almost every location, the average number of mites per female rat was higher than that per male at the same location, perhaps because females spend more time than males in the burrows. Miller (1918) noted the female mite habit of depositing eggs in the litter of the burrow or cage.

The rats collected were divided arbitrarily into two groups,

namely, small and large rats; those under 6½ inches in length were designated as small and those 6½ inches or longer as large. There appear to be no significant difference in mite populations of either group which would indicate a preference on the part of the mite for a young or an old host.

It was also possible to determine whether or not the abundance of the mite was subject to variations throughout the year. Five sites were found to have received visits more regularly than any others during the year, so these sites were chosen for a study of annual patterns.

The data from these five areas (Table II) show that the mite populations at these sites follow similar trends. At the beginning of the year the numbers of rats infested and the numbers of mites are very low or nil. With the advent of warmer weather, the proportion of rats infested as well as the number of mites begins to increase. By the middle of the summer the average number of rats infested has reached a high point. The average number of mites per animal has also reached a high point and leveled off. With the onset of the cooler months, mite abundance per rat and per cent of infestation begin to drop, until by the end of the year the lowest point in numbers of mites was reached. The two bottom lines give the seasonal trends by averages of the five sites listed in Table II in terms of the average number of rats infested by month and the average number of mites per rat by month.

At two of these five locations, Newark and Secaucus, more rats were collected throughout the year than at the other three locations. In each location the per cent of rats infested rises to a high in June, drops slightly in July, and rises again in August. In September the per cent of infestation drops once more and then rises to another high point in November after which the rate of infestation decreases. Three peaks of infestation during the year are thus suggested, which perhaps indicates activities of three generations of mites.

DISCUSSION AND SUMMARY

In a survey for ectoparasites in New Jersey, 2,738 Norway or brown rats were collected from refuse dumps and some buildings, and examined for parasites. Of these animals, 1,911 were found to be infested with *Laelaps echidninus,* a state-wide average in-

TABLE II.

TABLE II. MONTHLY *Laelaps echidninus* INFESTATION OF RATS AT FIVE DUMPS IN NEW JERSEY

Location	*Jan.*	*Feb.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
Fairview												
Total rats	0	0	0	0	10	23	26	51	10	0	18	0
% rats infested	—	—	—	—	10.0	65.2	50.0	56.8	70.0	—	22.2	—
Av. no. per rat	—	—	—	—	0.2	4.4	1.0	6.7	5.6	—	0.2	—
Jersey City												
Total rats	12	15	0	0	7	11	49	30	9	0	14	0
% rats infested	0	6.6	—	—	28.6	72.7	53.0	26.6	44.4	—	0	—
Av. no per rat	0	0.1	—	—	0.4	2.8	5.4	3.5	2.3	—	0	—
Newark												
Total rats	15	10	0	10	0	10	73	32	30	0	10	0
% rats infested	13.3	10.0	—	70.0	—	90.0	86.3	87.5	83.3	—	90.0	—
Av. no. per rat	0.3	0.1	—	1.6	—	21.3	9.9	14.6	8.4	—	9.4	—
North Arlington												
Total rats	0	10	0	0	0	10	32	51	28	0	11	0
% rats infested	—	20.0	—	—	—	20.0	78.1	64.7	64.2	—	0	—
Av. no. per rat	—	0.3	—	—	—	4.0	4.6	3.3	2.3	—	0	—
Secaucus												
Total rats	6	8	0	0	11	35	41	27	24	0	10	3
% rats infested	66.6	0	—	—	36.3	74.2	58.5	88.8	41.6	—	80.0	0
Av. no. per rat	2.0	0	—	—	4.3	11.1	6.8	4.3	3.0	—	1.3	0
% rats infested	19.3	9.3		70.0	29.1	67.4	68.3	63.8	64.6		33.3	0
Av. no. mites per rat	0.8	0.1		1.6	1.6	8.7	5.5	6.5	4.3		2.2	0

festation of 69 per cent. On these 1,911 rats, 6,567 specimens of *L. echidninus* were found, for an average of 3.4 mites per infested rat. A small number of rats was collected from dwellings, 5 per cent of which were infested with this mite.

A total of 76 locations was trapped for rats, and 29 were found to be inhabited by rats infested with this mite. The areas of heaviest infestation were found around northeastern New Jersey and the Camden metropolitan areas. Where a dump was found to be inhabited by high numbers of rats, the numbers of *L. echidninus* were usually also high. Away from densely populated areas and/or port facilities, the numbers of mite-infested rats and of mites were low or non-existent. This relationship suggests that the mite is present in those areas where rats infested with them have been introduced or dispersed by waterway shipping.

Throughout the year the numbers of *L. echidninus* were greater during the warmer months as was the per cent of rats infested by this mite. Perhaps warmer weather was more suitable for mite reproduction and perhaps, also, for increased activity of the host in terms of mating, bearing of young, and ease of movement, all of which may tend to bring about more contact among the rats and greater numbers of the host and the mite.

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The reptiles and amphibians are almost lacking—three species of frogs and a garter snake.

The arctic fish are chiefly marine. The absence of fresh water fish is due to the early freezing of the shallow lakes. This not only kills the fish but the aquatic insects as well. The mosquitoes overwinter as eggs.

The arctic fauna is a homogeneous one; there is no clear demarcation between palearctic and arctic fauna. The holarctic is the proper designation.

Insects with incomplete metamorphosis do poorly in the arctic. An exception are the collembola. The arctic lepidoptera do not hibernate in the pupal stage. They have an obligatory diapause as first, second or third instar larvae.

There are about 30 species of butterflies in the arctic. One (doubtful) Papilonid, six Pierids, 14–15 Satyrids (they are notorious slow growers—they have a two year life cycle), 5 Nymphalids (chiefly *Bolopia*), two Lycaenids and one Skipper.

Dr. Klots illustrated his remarks with Kodachrome slides. After an interesting question period, the meeting adjourned at 9:45 P.M.

LOUIS S. MARKS, *Secretary*

MEETING OF JANUARY 3, 1956

The annual meeting of the Society was held on January 3, 1956 in Room 129 American Museum of Natural History. President Vishniac presided. There were 19 members and 19 guests present. The president welcomed the members and guests and introduced Mrs. Su Zan Swain, an honorary member of our Society.

The minutes of the previous meeting were approved as read. As this was the annual meeting, the secretary verified the quorum present.

Th president reported on the state of the society. The state of affairs is good. The society in the recent past has had certain external and internal difficulties. The difficulty of publication of the Journal appears resolved. The Journal will be printed by the old printer. The president has had a letter from Dr. Hagen, our past president. Dr. Vishniac noted all the past

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